

Comparison of intravoxel incoherent motion characteristics between different tumor stages and grades in rectal cancer

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Background

The bi-exponential analysis in Intravoxel Incoherent Motion (IVIM) model can separate microscopic circulation perfusion with pure water diffusion, which has been applied in many diseases, including colorectal cancer liver metastases [1-4]. However, its relationship with pathophysiology of the rectal cancer such as stage and grade has not clarified.

Purpose

To evaluate the intravoxel incoherent motion (IVIM) characteristics and relationships with tumor stage and grade in rectal cancer.

Methods

Fifty-two patients (mean age, 59.5 ± 13.7), including 30 men and 22 women with histologically proved rectal cancer were prospectively enrolled from August 2013 to October 2014. Diffusion-weighted MR imaging (Philips 3.0T Ingenia, Philips Medical Systems, The Netherlands) was performed and IVIM parameters (D, pure diffusion; f, perfusion fraction; D*, pseudodiffusion coefficient) were calculated using echo-planar DW-MRI with eight b values (0, 25, 50, 75, 150, 400, 800 and 1000s/mm²). Patients were stratified into different tumor stages (I, II, III, IV) based on American Joint Committee on Cancer (AJCC) and different grades (poorly, moderately, well differentiated) according to finally pathological results. Tumor IVIM parameters and clinicopathological parameters were analyzed by Spearman correlation analysis and ANOVA, respectively. Tumor IVIM parameters between lymph nodes metastasis positive group and negative group were compared by using independent samples t test. $P < 0.05$ was considered to indicate a statistically significant difference.

Results

The average tumor length was 4.86 ± 1.51 cm, 52 patients including 17 stage I, 19 stage II, 16 stage (III+IV) were defined according to AJCC cancer staging handbook 7th Edition; 16 poorly differentiated, 22 moderately differentiated, 14 well differentiated; 16 lymph nodes metastasis positive patients and 36 negative patients by postoperative pathological results. D, f and D* were lower values in higher stage groups, D and D* both showed statistically significant in different stage groups ($F=8.210$, $P=0.001$; $F=9.572$, $P<0.001$), and significant correlation with tumor stage ($r=0.476$, $P<0.001$; $r=0.476$, $P<0.001$), whereas f values showed no statistical difference in different stage groups ($F=1.385$, $P=0.260$). f and D* were higher in well differentiated group ($f=0.325$, $D^*=91.886 \times 10^{-3}$ mm²/s) than in poorly ($f=0.237$, $D^*=67.400 \times 10^{-3}$ mm²/s),

Table 1 Tumor IVIM parameters between lymph nodes metastasis positive group and negative group

IVIM parameters	Positive(N=16)	negative(N=36)	P
D ($\times 10^{-3}$ mm ² /s)	0.555 \pm 0.292	0.852 \pm 0.364	0.006
D* ($\times 10^{-3}$ mm ² /s)	59.063 \pm 16.443	84.081 \pm 27.744	0.002
f (%)	24.350 \pm 7.162	28.139 \pm 6.648	0.07

moderately ($f=0.258$, $D^*=73.050 \times 10^{-3}$ mm²/s) differentiated group ($F=8.503$, $P=0.001$; $F=3.635$, $P=0.034$), and D values showed no significant difference in different grade groups ($F=0.080$, $P=0.923$). (Fig.1) Lymph nodes metastasis positive group showed lower D, and D* values than negative group ($D=0.852 \times 10^{-3}$ mm²/s, $D^*=84.081 \times 10^{-3}$ mm²/s, $P=0.006$; $P=0.002$). (Table.1)

Conclusion

The IVIM parameters demonstrated well correlation with tumor stage and grade, which could reflect clinicopathological features of rectal cancer.

References 1. Le Bihan D, Breton E, Lallemand D, et al. Separation of diffusion and perfusion in intravoxel incoherent motion MR imaging. *Radiology*. 1988;168(2):497-505.

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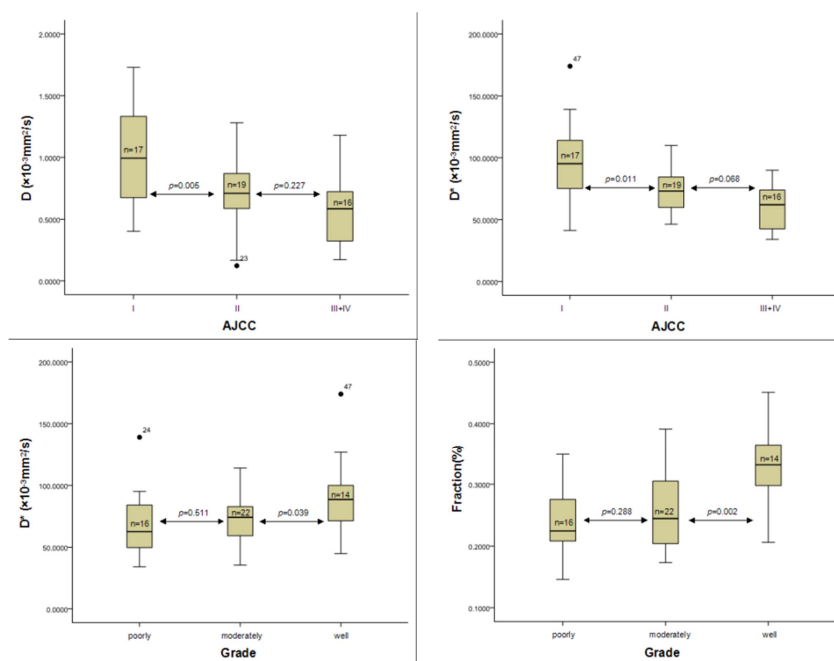


Figure 1. Tumor IVIM parameters in different stages and grades.

First list. Rectal tumor IVIM parameters (D and D*) showed statistically difference in different stage groups. D and D* were lower values in higher stage groups ($p=0.005$; $p=0.011$). Second list. IVIM parameters (D* and f) showed statistically difference among well, moderately, poorly differentiated rectal tumor. D* and f were higher in well differentiated group ($p=0.039$; $p=0.002$).